Soil texture, land use intensity, and vegetation of Fort Benning sandhills sites

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ABSTRACT

This SERDP/SEMP-funded project is comparing vegetation and nitrogen cycling among upland sites at Fort Benning that are managed primarily for longleaf pine (thinned, burned at 3 -yr intervals) and differ in soil texture (from sandy to clayey) and intensity of military training (lighter infantry vs. heavier mechanized training). We wish to determine if there are thresholds beyond which upland ecosystems cannot sustain the combined effects of forest management and military traffic disturbances. Baseline surveys were conducted to characterize canopy and ground layer vegetation of 32 sites. These sites were burned in spring, 2000, and will be subjected to an accelerated (2 yr) or delayed (4 yr) burn cycle to evaluate the combined effects of forest management and military training intensity on ecosystem response. As part of the baseline study, we also characterized soil texture and land use disturbance among the sites, and asked if canopy and ground layer vegetation measures (species composition and richness, basal area, abundance) differ among sites on the basis of soil texture or land use. Trees were surveyed using the point quarter method and ground layer vegetation was surveyed by line-intercept at 25 points in a 100 m x 100 m plot in each site. Soil texture was determined from nine samples in each site. Land use intensity was assessed by line intercept of disturbance features along two 300 m transects in each 400 m x 400 m site. There was significant interaction between land use and soil texture, with a gradient of percent clay from clayey sites in light training areas, to sandy sites in heavier training areas. Road-like features, including active and remnant trails, roads, and vehicle tracks or trails were the most frequent and abundant disturbance feature. Disturbance feature richness did not differ among landuse/soil texture categories. Differences in ground layer and canopy composition among sites scaled by disturbance intensity; differences in canopy composition also reflected the proportion of pine. There was a gradient of species richness in ground layer vegetation from heavily disturbed sites with clayey soil, through lightly disturbed sites, to heavily disturbed sites with sandy soil. Our results suggest upland forests at Fort Benning include sandhills scrub oak-pine vegetation, longleaf or loblolly pine-hardwoods, shortleaf pine-hardwoods, and oak-hickory forests, with greater species diversity in the understory of clayey sites. Disturbances associated with mechanized military training and forestry practices may favor pine dominance and maintain open-site, successional or fire-tolerant species in the understory.

INTRODUCTION

Ft. Benning is located in southeastern Georgia within the Fall Line Sandhills District of the Coastal Plain and the Piedmont physiographic provinces. Our longterm objective is to evaluate the ecological effects of military training (Figure 1) and forest management for longleaf pine at Ft. Benning, to determine if there are thresholds beyond which upland ecosystems cannot sustain the combined effects of burning and military traffic disturbances. We hypothesize that soil type (sandy vs. clayey) (Figure 2) influences nutrient cycling, species diversity, and vegetation dynamics, as well as the threshold for sustainability of land use disturbances.

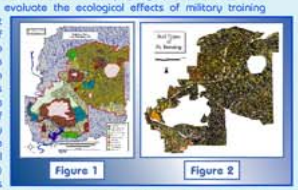

Figure 1 Figure 2

METHODS

- We compared canopy and ground layer vegetation, soil texture, and soil N of sandy (S) and clayey (C) sites subjected to heavier (H) or lighter (L) military use (8 400m x 400m sites of each combination; Figure 3). All sites were burned in spring, 2000.
- Disturbance features were surveyed by line intercept along 2 300m transects in each site.
- A 100m x 100m plot was established in each site to survey vegetation. Five transects, with sampling points at every 20 m, were established at 20 m intervals within the plot (total 25 points). At each point, trees were surveyed by the point quarter method and ground cover was sampled by line intercept along a 6 m transect.
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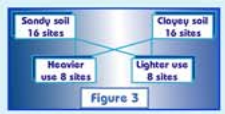
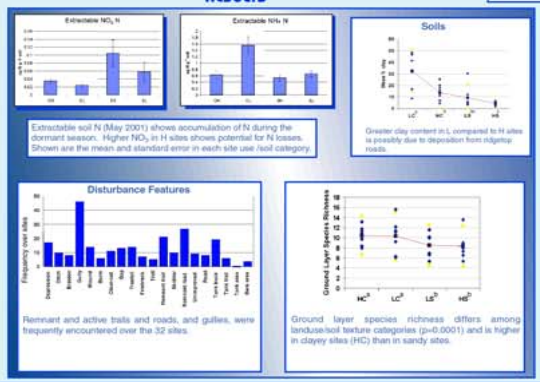


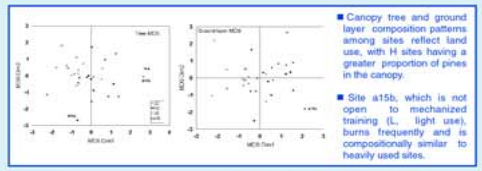
Figure 3

DATA ANALYSES

- Soil texture and chemistry, and vegetation measures, were compared among the four landuse/soil texture categories (HC, HS, LC, LS) using analysis of variance. In the ANOVA plots, we show category means (squares) and standard deviations (circles), and the mean of sites within each landuse/soil texture category (diamonds). Category means with the same letter do not differ significantly. Multidimensional (MDS) scaling was used to summarize trends in canopy and ground layer composition among sites.

RESULTS





- Canopy tree and ground layer composition patterns among sites reflect land use, with H sites having a greater proportion of pines in the canopy.
- Site a15b, which is not open to mechanized training (L, light use), burns frequently and is compositionally similar to heavily used sites.

CONCLUSIONS

Land use at Fort Benning leaves small-scale features such as gullies, trails, and roads, and potentially affects soil texture and chemistry, and vegetation composition. Our preliminary results suggest soil texture in heavily used sites, those open to mechanized training, reflects sand deposition from upslope. These sites also may have a greater potential for nitrogen loss following soil disturbance. Clayey sites appear to be more productive and richer. More heavily used sites have a high proportion of pines in the canopy, lower tree density, and an "open site" ground layer. Goals of upland forest management at Fort Benning are to sustain the military mission and promote the longleaf pine ecosystem, which supports the endangered red-cockaded woodpecker. Upland pine ecosystems may be favored by military training and forest management practices such as frequent prescribed burning.

ACKNOWLEDGEMENTS

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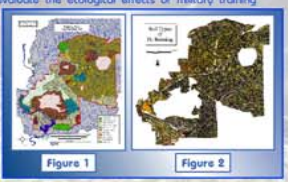

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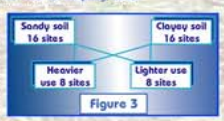

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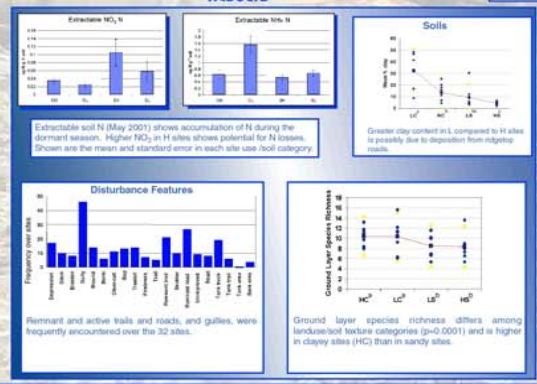
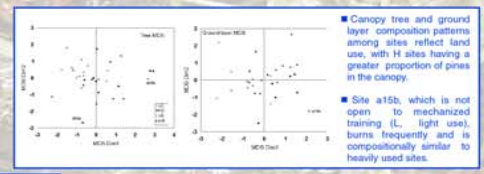


Extractable soil N (May 2001) shows accumulation of N during the dormant season. Higher NO_3 in H sites shows potential for N losses. Shown are the mean and standard error in each site use /soil category.

Greater clay content in L compared to H sites is possibly due to deposition from ridgetop roads.

Remnant and active trails and roads, and gullies, were frequently encountered over the 32 sites.

Ground layer species richness differs among landuse/soil texture categories ($p<0.0001$) and is higher in clayey sites (HC) than in sandy sites.



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